

Wildlife Disease Surveillance: lessons from frogs

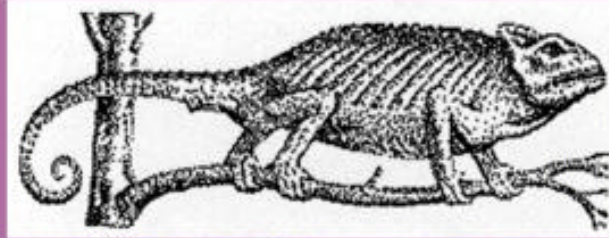
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LIVING CONSERVATION

Global Amphibian Declines



World Congress
of Herpetology

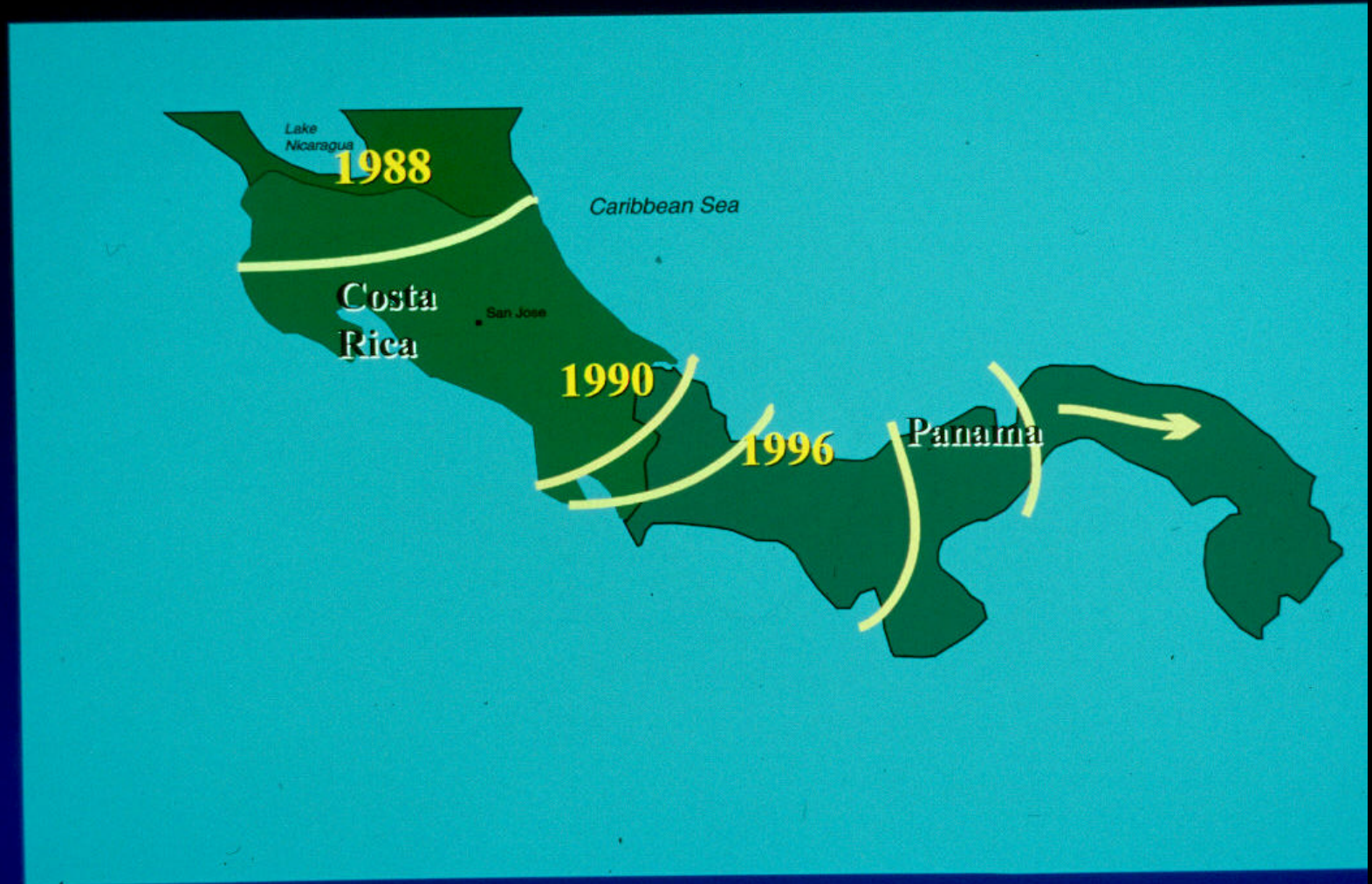
- Amphibians are undergoing unprecedented declines around the world **including** in **protected areas** and in **pristine habitats**.
- Declines were initially ascribed to natural population cycles, habitat destruction, excessive UV-B irradiation, pesticide use, acid rain, other pollutants, etc...

Amphibian declines - Australia

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Amphibian declines – Central America



Amphibian declines – mortality driven

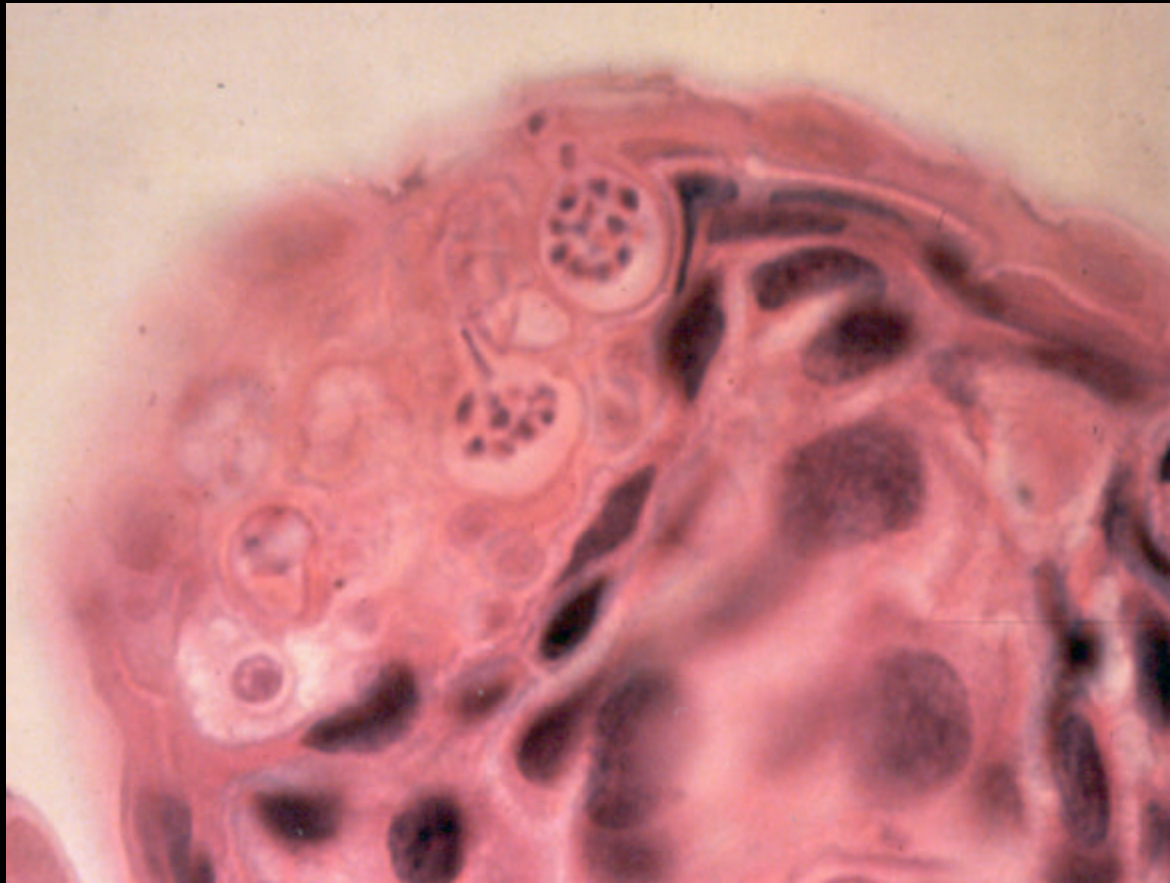
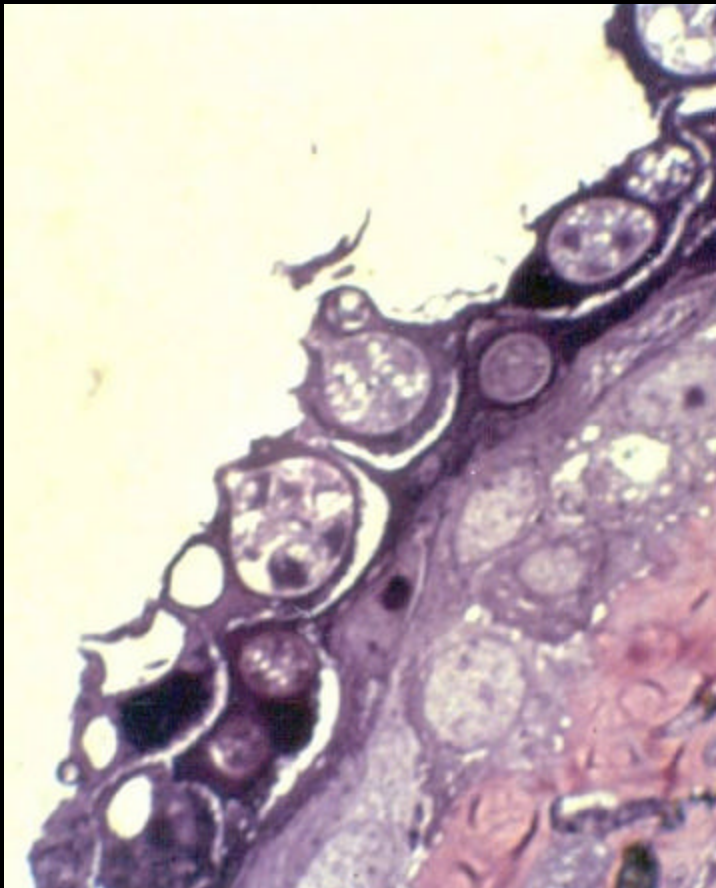


White's tree frog, *Litoria caerulea*

Cutaneous chytridiomycosis



Batrachochytrium dendrobatidis, a non-hyphal zoosporic chytrid fungus

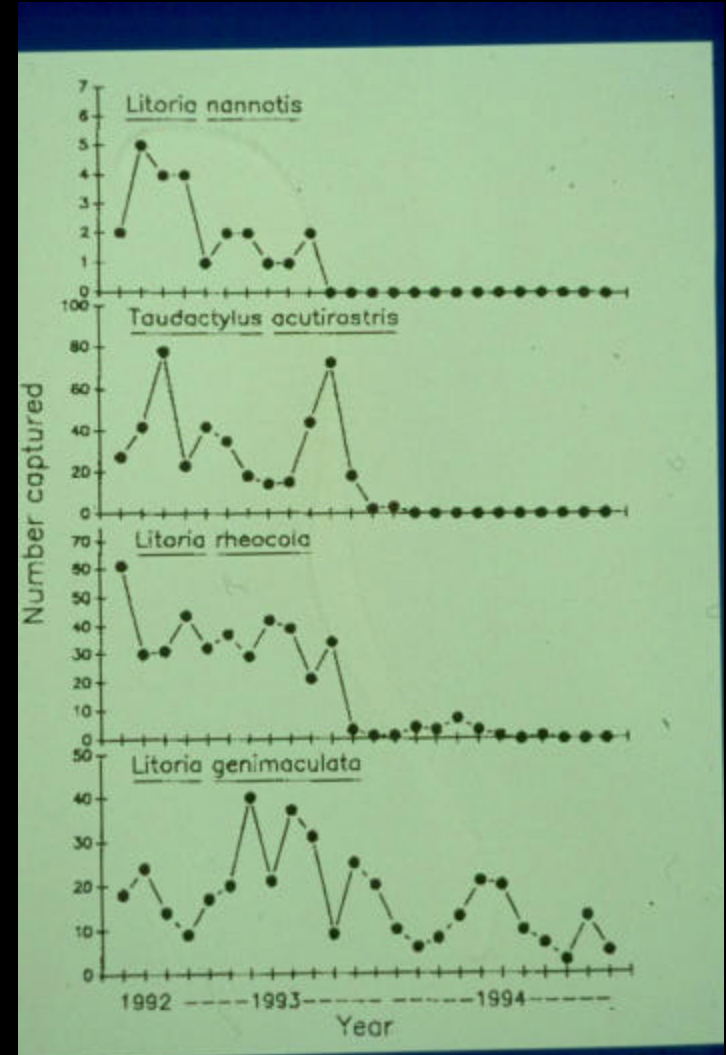


Berger *et al.* (1998) *P.N.A.S.* 95, 9031-9036.

Global declines of amphibians



Mixophyes fasciolatus

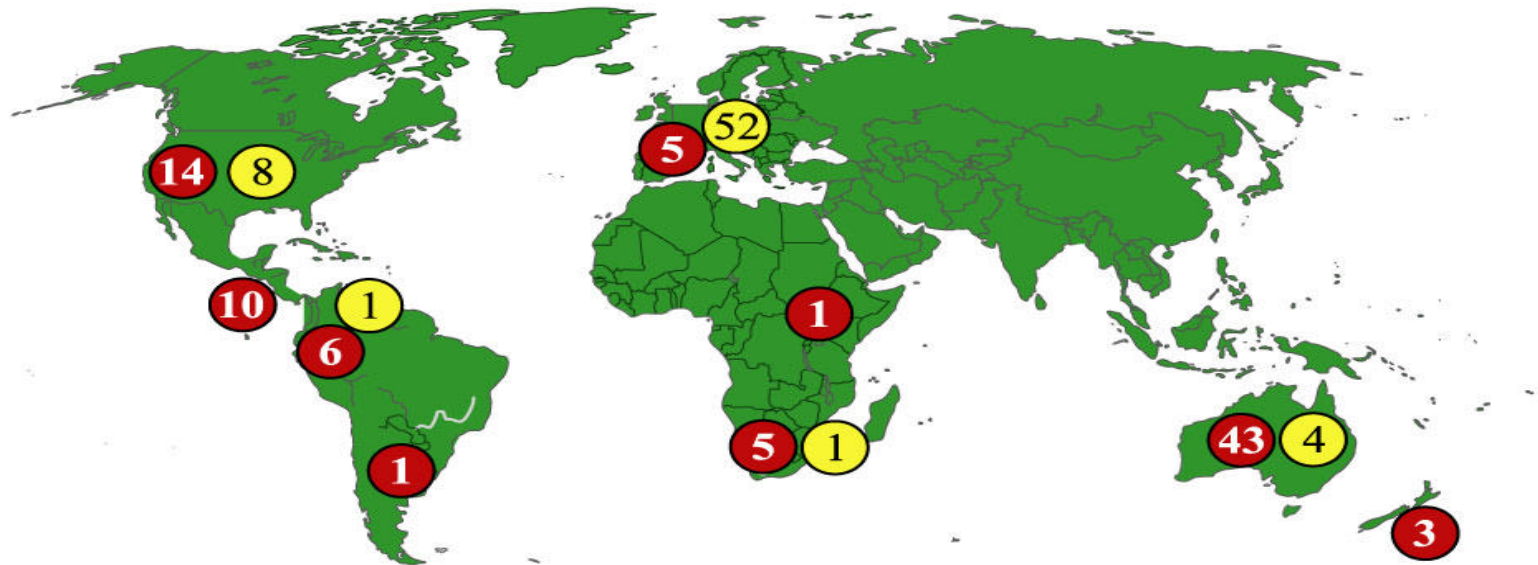


Amphibian declines in valleys, 1993-1998

Known global distribution of *B. dendrobatidis*



Global Distribution of Chytrid fungus



= number of species with chytrid - reported in wild populations

= number of species with chytrid - reported in captive populations

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> 100 species, at least 14 families, 5 continents

Chytridiomycosis – a global emerging disease



- Histological surveys of museum specimens up to 10 years prior to epidemics and associated catastrophic population declines (Australia, Central & South America) have revealed no evidence of infection
- The disease was discovered independently, and contemporaneously, on separate continents
- The epidemic mortality and rapid population declines associated with infection are characteristic of the declines observed when novel pathogens infect a population.

Extinction due to chytridiomycosis?

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Bufo periglenes



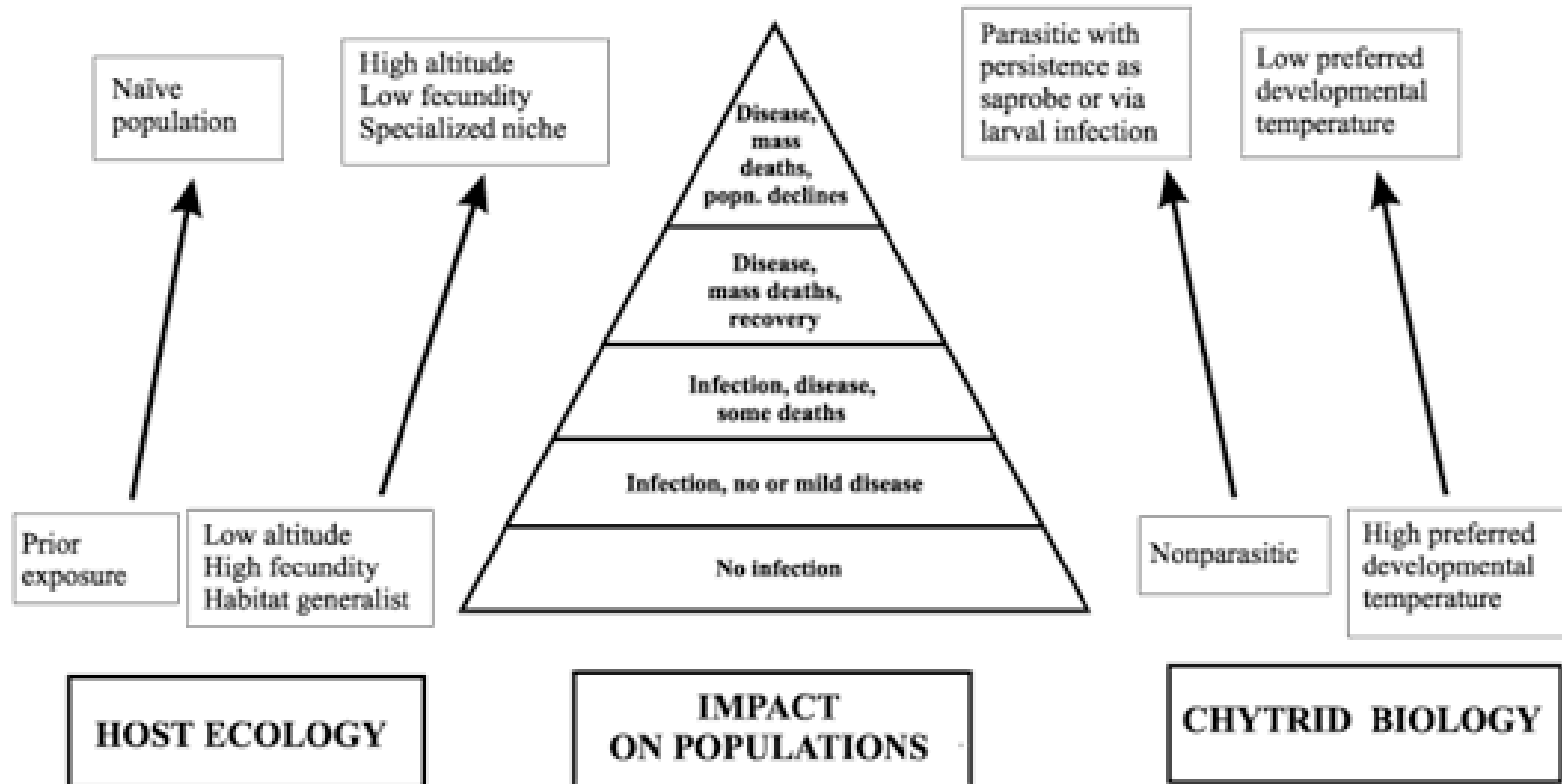
Rheobatrachus vitellinus
Rheobatrachus silus

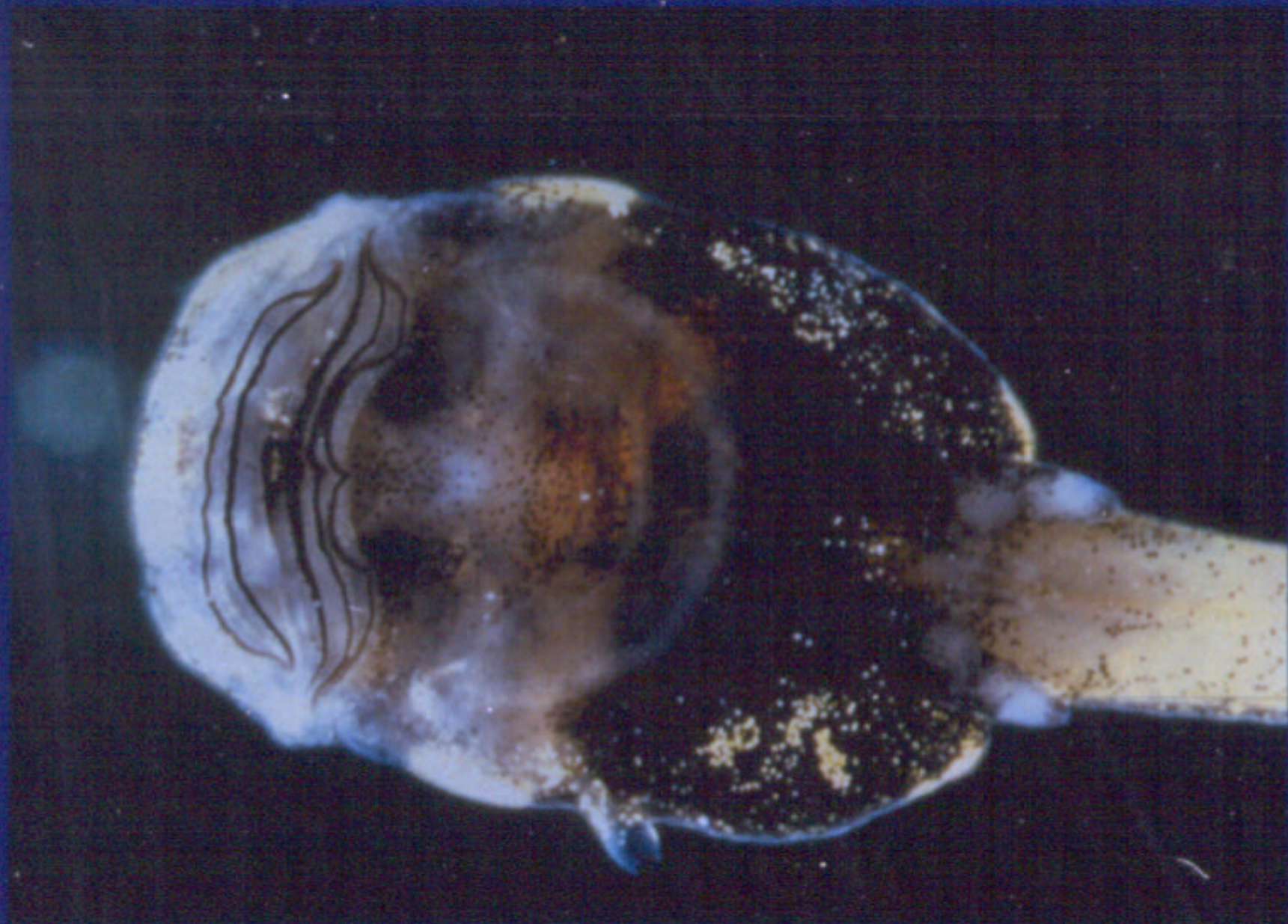
Beginnings of a mass extinction?



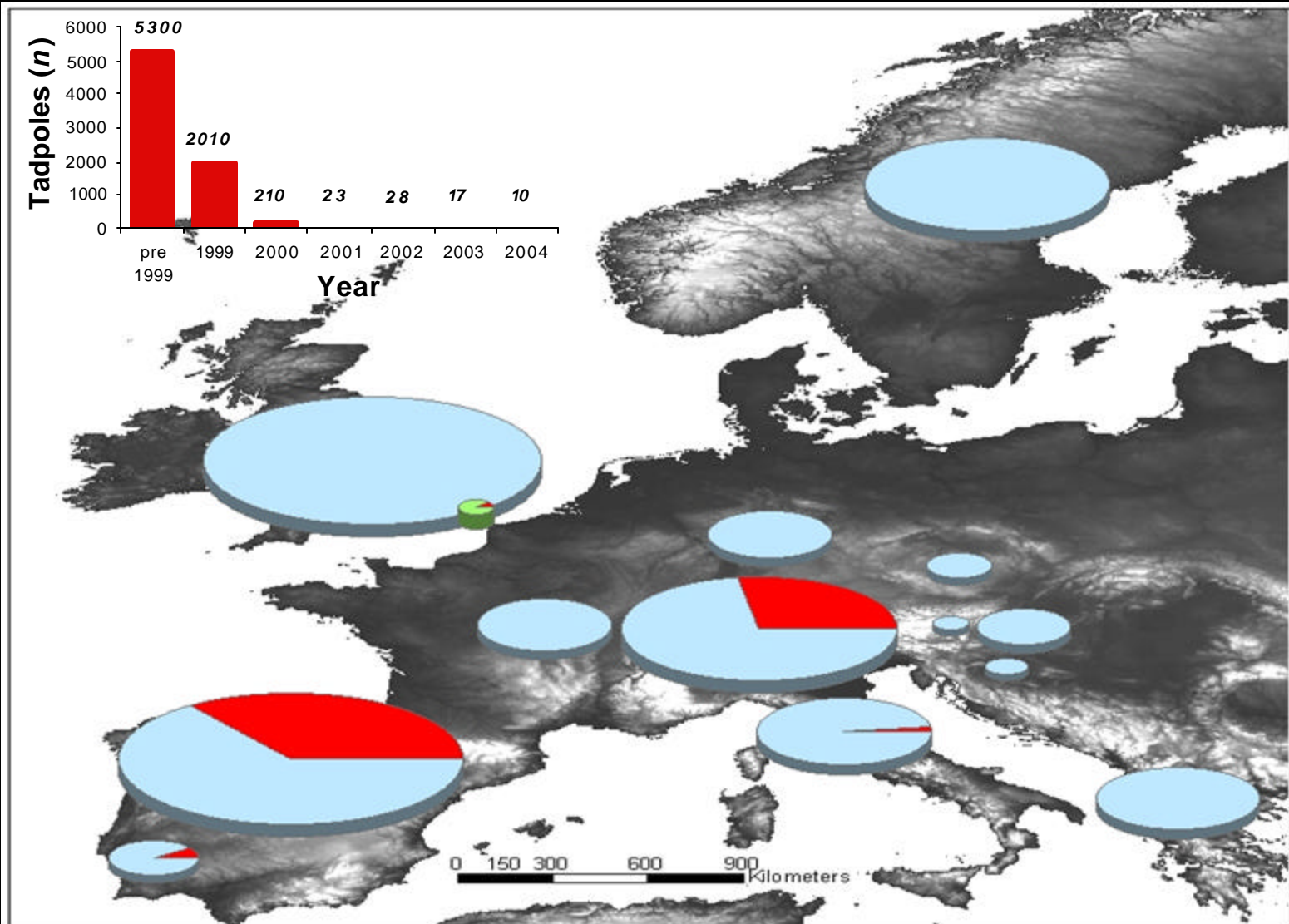
- Since the 1970s, precipitous declines and extinctions of amphibian species have been observed, most significantly in protected areas.
- Nearly one-third (32 %) of the world's amphibian species—representing 1,856 species—are threatened with extinction.
- Up to 122 species may have become extinct since 1980.
- At least 43 % of all amphibian species are declining in population size.
- Chytridiomycosis causes loss of multi-species assemblages.

Chytridiomycosis and amphibian declines





Chytrid in Europe



Chytrid in the U.K.



- Detected in two adult American bullfrogs in south east England, 2004
- Wiped out a captive population of *Bufo calamita* (species has been part of an EN action plan for over a decade)



Assessing the chytrid threat to UK amphibians





Frog Mortality Project



NEW CASE IN 1993 - FROG MORTALITY PROJECT

Contact ref:

Name:	
Address:	
Code:	County:
Tel. No. Day:	Even:

Dates of contact by reported

1st contact: - - 92

2nd contact: - - 92

Years of reported mortality

Before 1989	1991
1989	1992
1990	1993

Month of 1st & last deaths in most recent year of mortality

1 st :
Last:

No. dead frogs in last year of mortality

Number dead so far in 1993:

If die-off has stopped in 1993, or total for most recent year of mortality:

1 - 5	61 - 80
6 - 10	81 - 100
11 - 20	101 - 150
21 - 40	151 - 200
41 - 60	201 - 300

Amount of spawn in most recent year of mortality

Number of blobs of spawn:
Square feet of spawn:

Number of healthy frogs in most recent year of mortality

1 - 10	41 - 60
11 - 20	61 - 80
21 - 40	Other:

If mortalities have occurred in more than 1 year, has there been a(n):

Continued decrease in no. frogs
Increased recovery in no. frogs
Or are numbers of frogs stable at a low level

Disease symptoms

No apparent symptoms

Skin colour

Pale body colour

Discoloured skin and/or legs

Red spots on the body

Skin appearance

Warts or blisters

Sores or ulcers

Sloughing skin

Body shape/size

Thin and/or emaciated

Bleated

Contorted and/or having spasms

General body condition

Protruding blood vessels

Bleeding

Eye problems

Burst abdomens

Breakdown of limbs

Protruding tongue

Other:

Setting

Highly urban

Suburban

Rural village

Open countryside

Size of garden

< 100 x 30 feet

Bigger than above, but < 200 x 30 feet

Bigger than above, but < 300 x 30 feet

> 300 x 30 feet

Pond size

Max. length metres

Max. width metres

Shape

Max. depth metres

Pond lining

Butyl liner

Plastic sheeting

Cast hard plastic

Fibreglass

Cast concrete

Natural clay or puddling

Metal tank or bath

Pottery or sink

Other:

Don't know

Pond age

Pond age: Years

Year built 19

Water source

Tap water originally

now rain & seepage

Tap water originally & topped up with tap water

Tap water originally & topped up with rainbutt/storage

Rain & groundwater only

Spring source

Other

Clarity

Clear & very clear

Some visibility

No visibility

NEW CASE IN 1993 - FROG MORTALITY PROJECT QUESTIONNAIRE continued

Shading

Is the pond very shaded, or

Does it have some shading, or

Is it unshaded

Silt

Is the pond very heavily silted, or

Does it have some silt, or

Does it have no silt

Vegetation

Submerged/underwater plants:

None Some Lots

Floating:

None Some Lots

Marginal:

None Some Lots

Vegetation management

Do you ever remove vegetation from your pond

Is vegetation regularly removed

Do you buy pond plants from garden centres

Fish

Are fish present in the pond in 1993

Types of fish:

Were there any fish deaths:

Before the frog mortality

During the frog mortality

After the frog mortality

Were there any fish deaths prior to the 1993 mortality

"Fishcare" remedies

Are they ever used in the pond

Have they been used this year

Brands:

Other animals in pond

Toads

Newts

Snails

Dragonflies

Chemicals/fertilisers in garden

Are any chemicals used at all

Do you use slug pellets

Do you use fertilisers

Do you use weedkillers

Other:

Brands:

Neighbours use them

Chemicals in pond

Do you use algicide in the pond

Other chemicals:

Brands:

Spawn & Tadpoles

Have you moved spawn into your pond recently

Have you moved spawn out of your pond recently

How spawn at all

All spawn failed

Some spawn hatched

All tadpoles died suddenly

All tadpoles died after a period

Some tadpoles grew legs & left water

Slug population

Are there slugs in your garden

Has there been an increase

Has there been a decrease

Are numbers stable/no change

Fountain in garden

Fountain present

Notes:

Incidents of frog mortality reported

year	no. incidents of mortality reported	no. incidents of unusual [†] mortality		number of dead frogs from incidents of unusual [†] mortality		
				total	range	median
1992	303	251 (83%) [#]		6404	1-315	12
1993	423	340 (80%)		8617	1-2000	10
1994	268	213 (79%)		2881	1-81	10
1995	1080	947 (88%)		19773	1-500	11
1996	608	533 (88%)		9259	1-250	12
1997	809	725 (90%)		15235	1-197	15
total	3491	3009 (86%)		62169	1-2000	12

[†] unusual = five or more dead frogs reported from same incident, or one or more of the following abnormalities observed: red spots on body; sores or ulcers; thin or emaciated; bleeding; breakdown of limbs; lethargy; [#] numbers in brackets = proportion of incidents as percentage of all incidents reported.

Ulcerative skin disease syndrome

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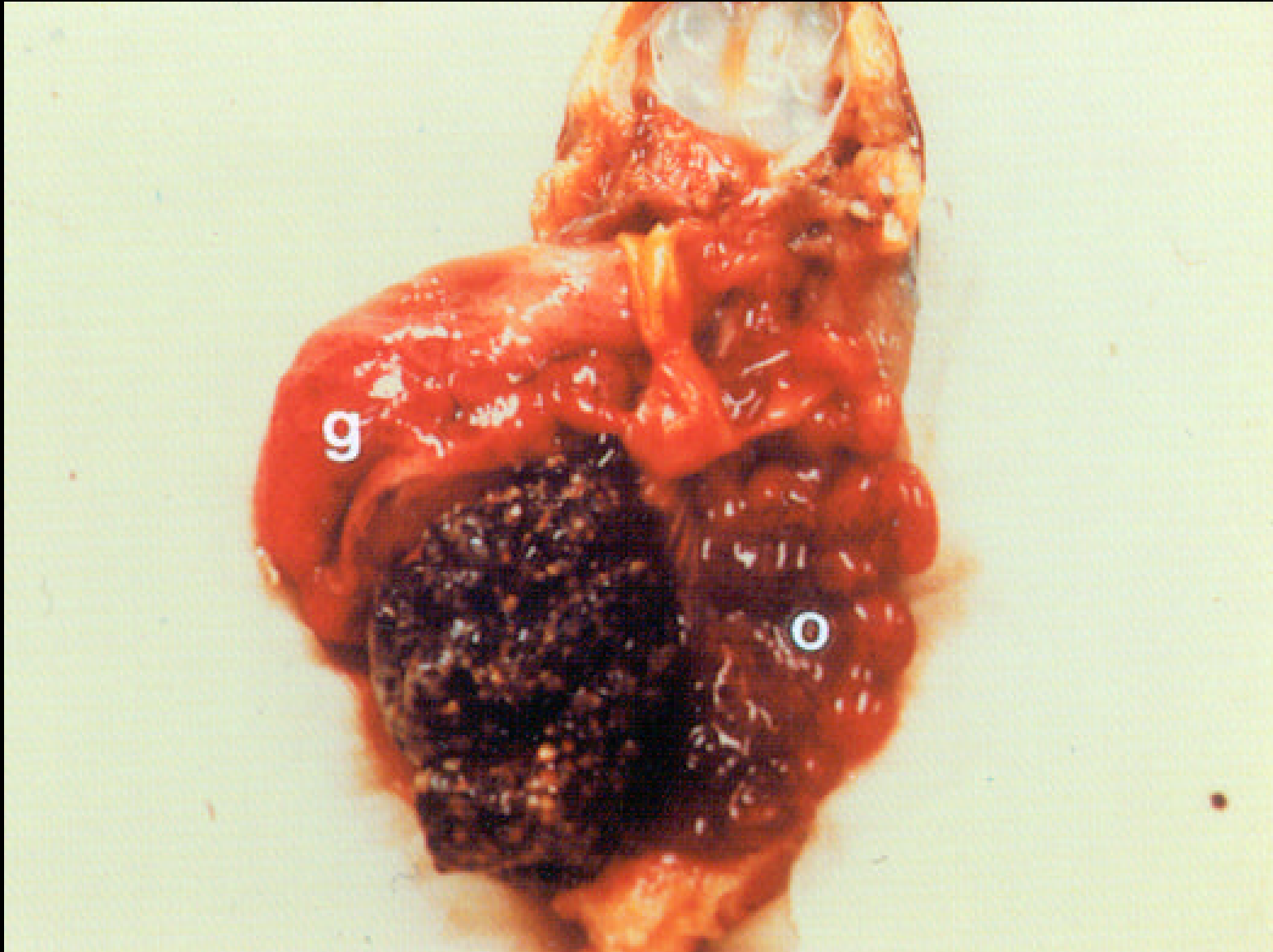
Ulcerative skin disease syndrome

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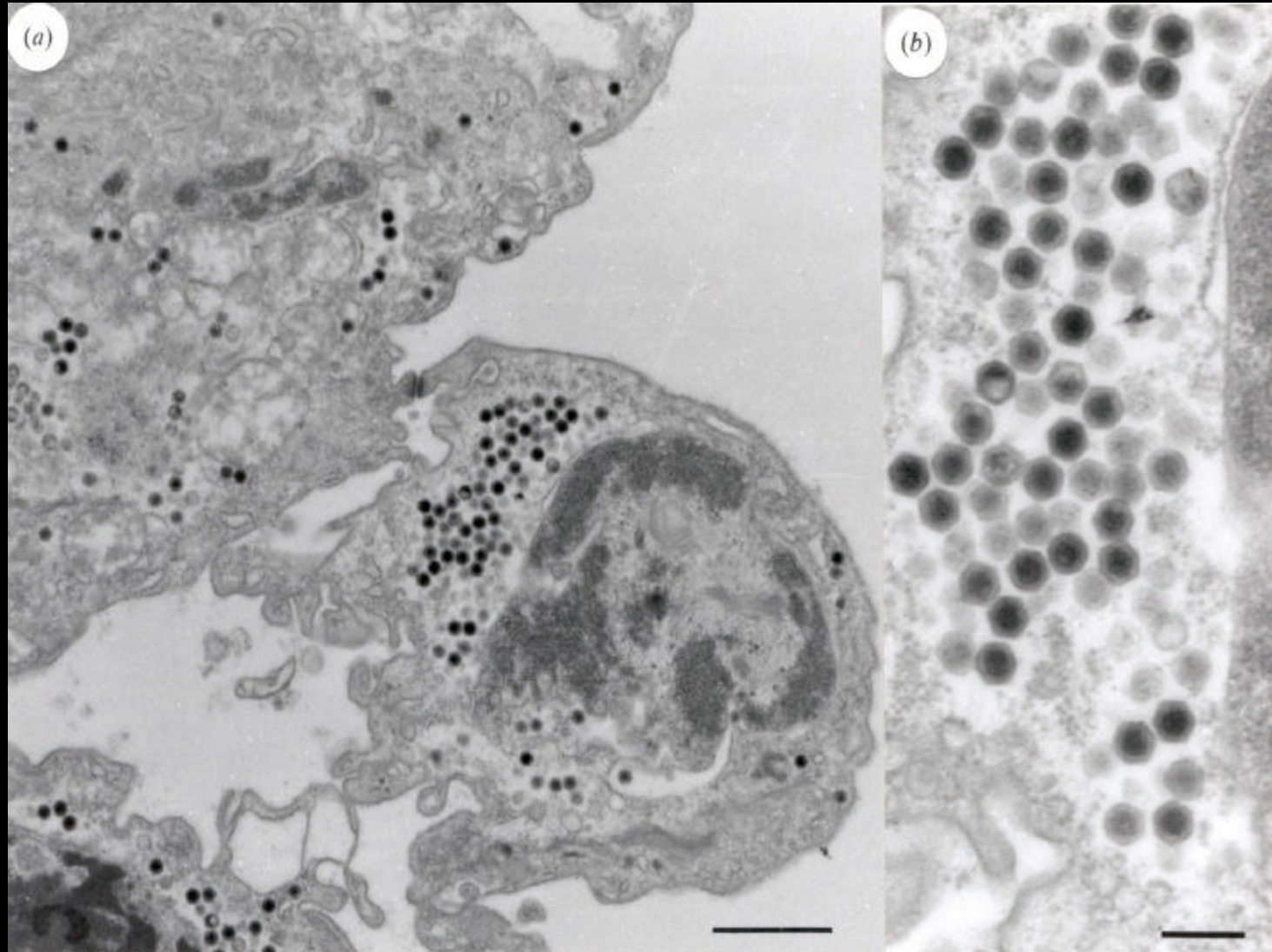


Haemorrhagic disease syndrome

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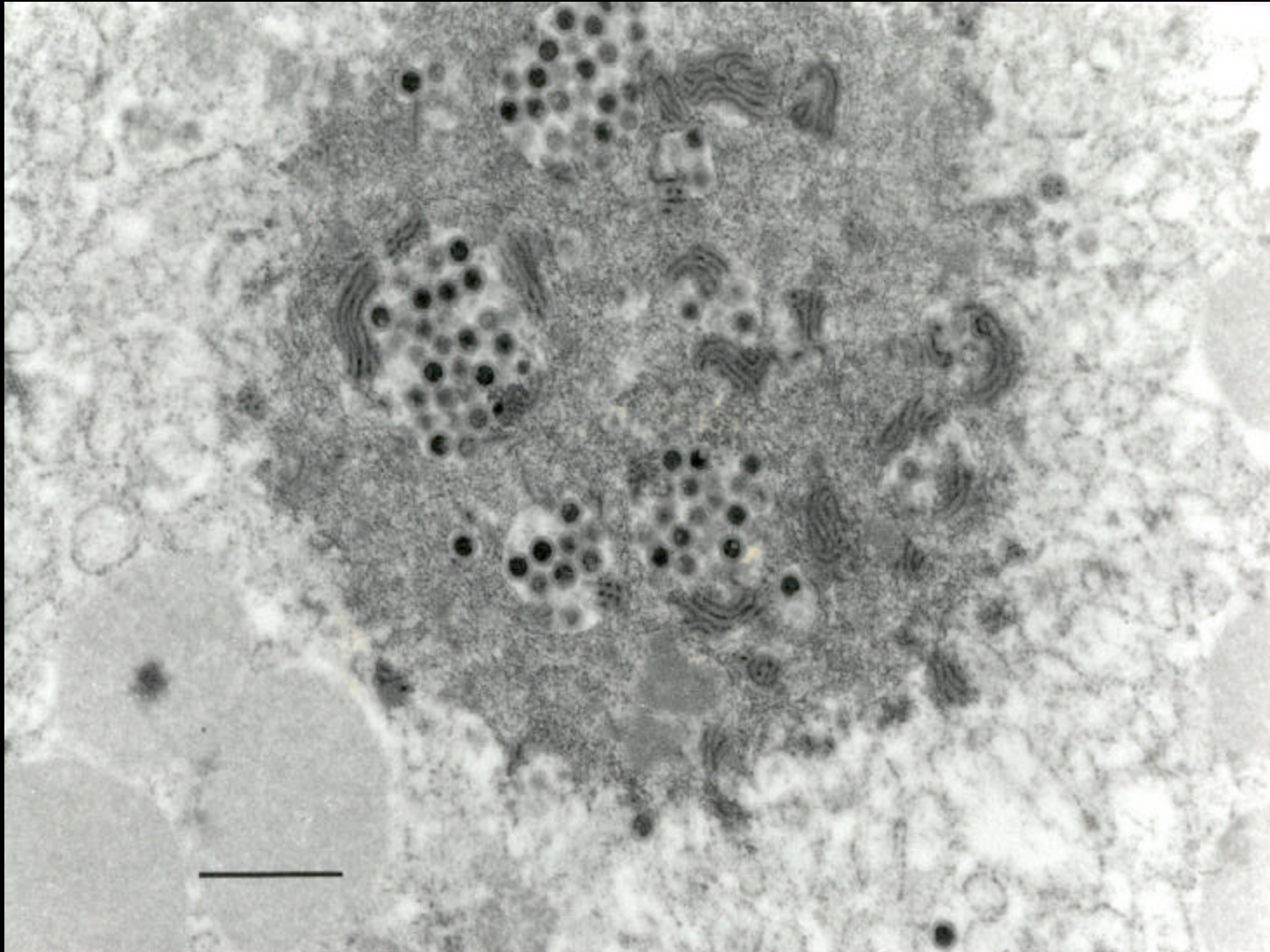


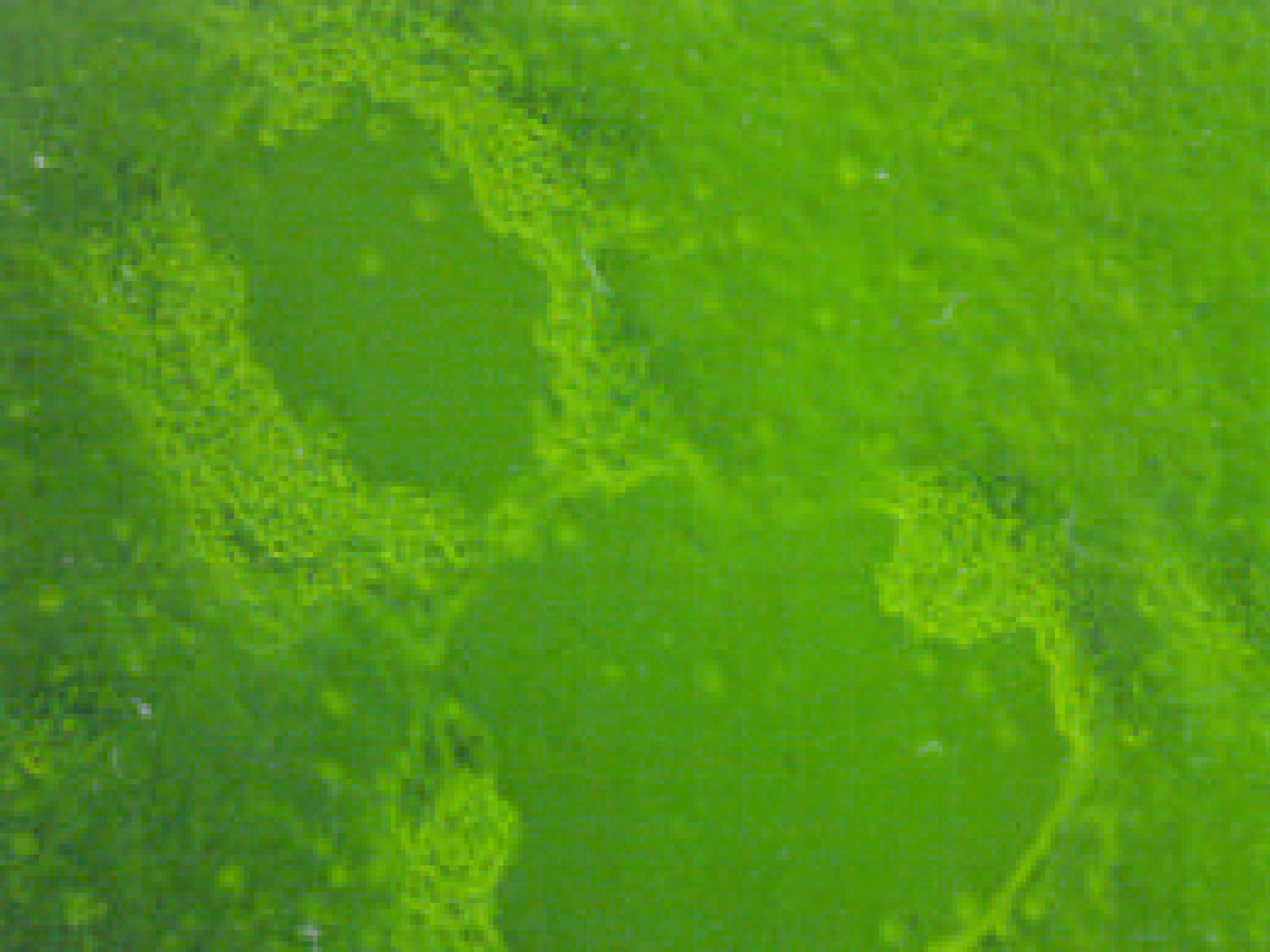
Epidermis - EM of edge of skin ulcer

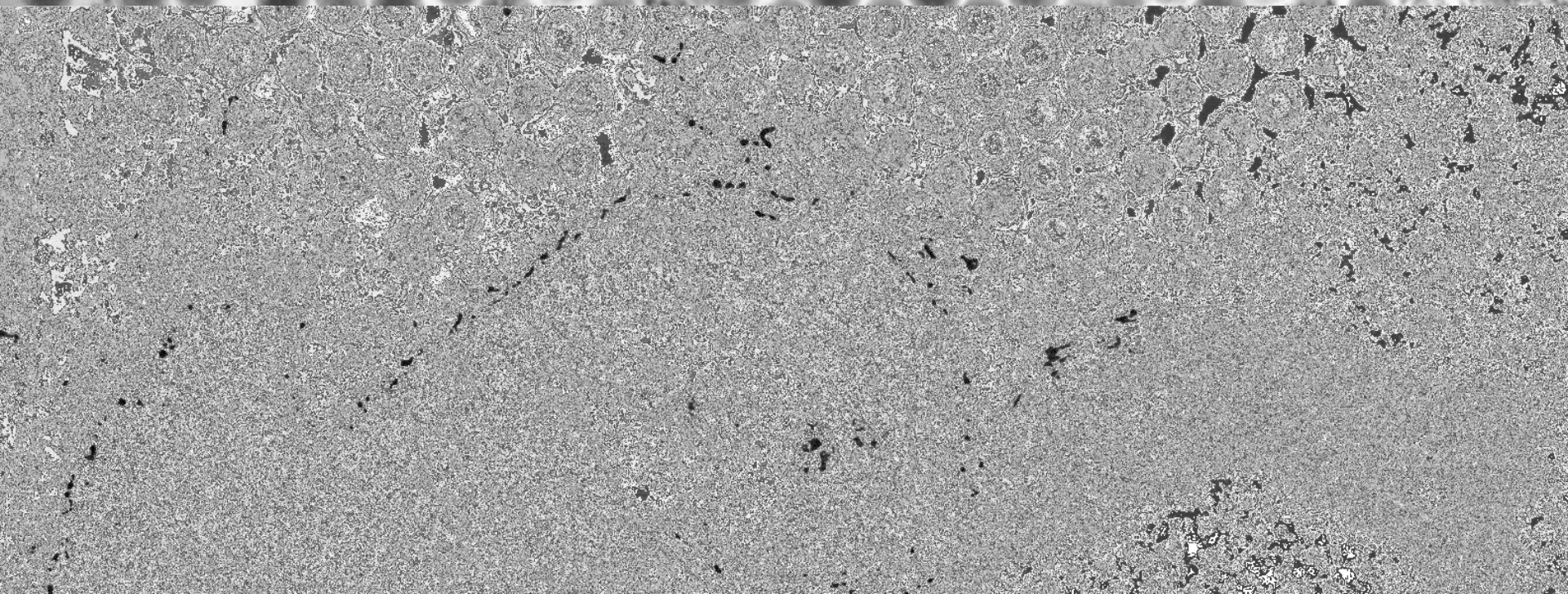
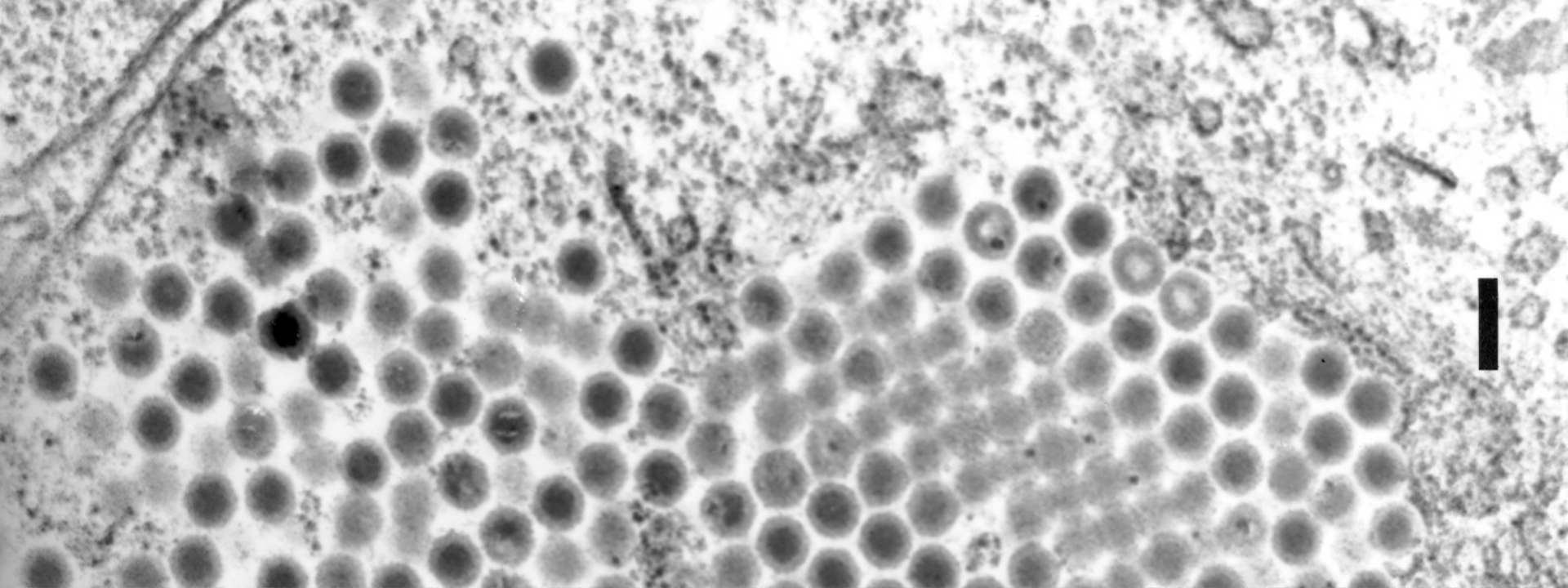


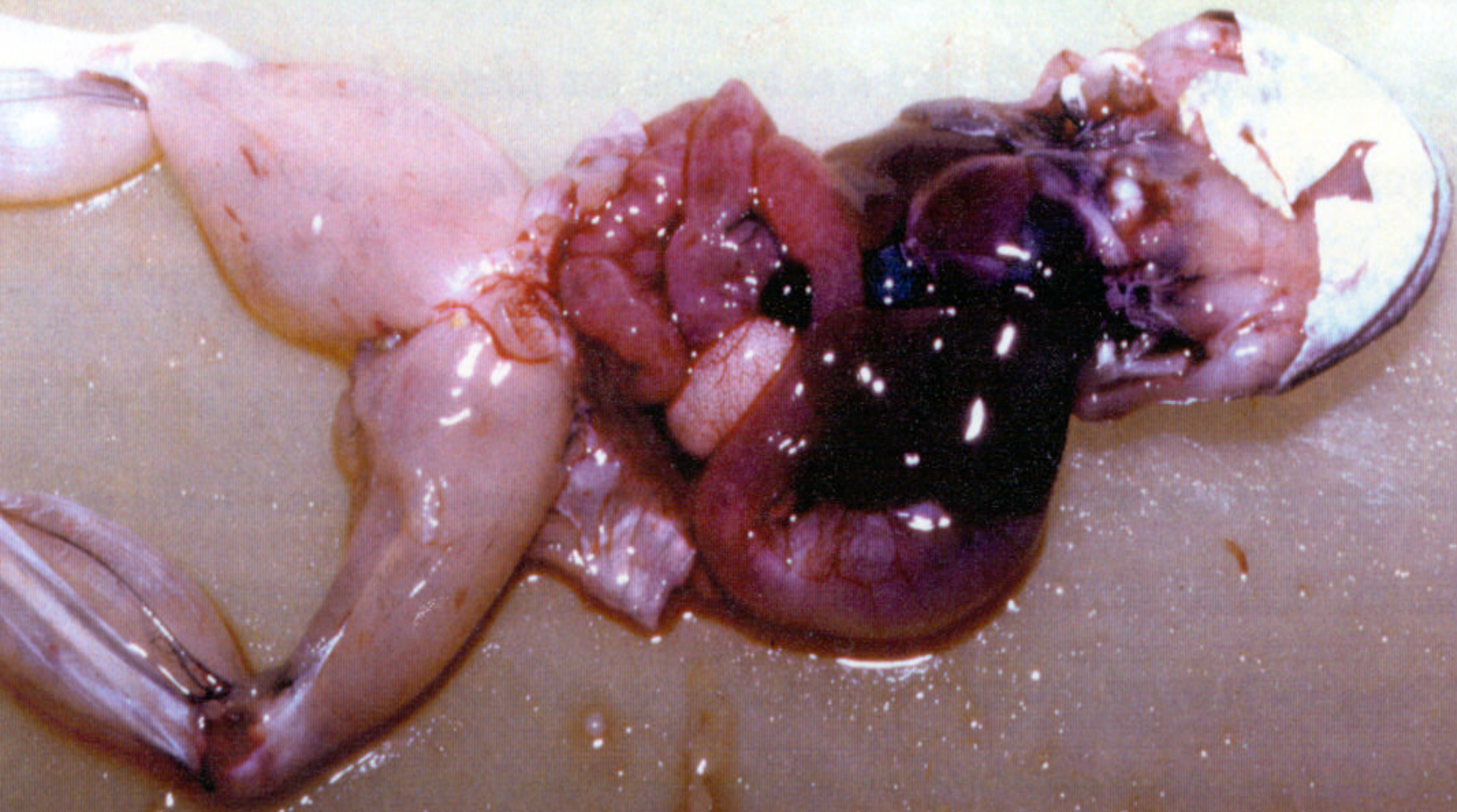
Liver - EM of basophilic i/c inclusion

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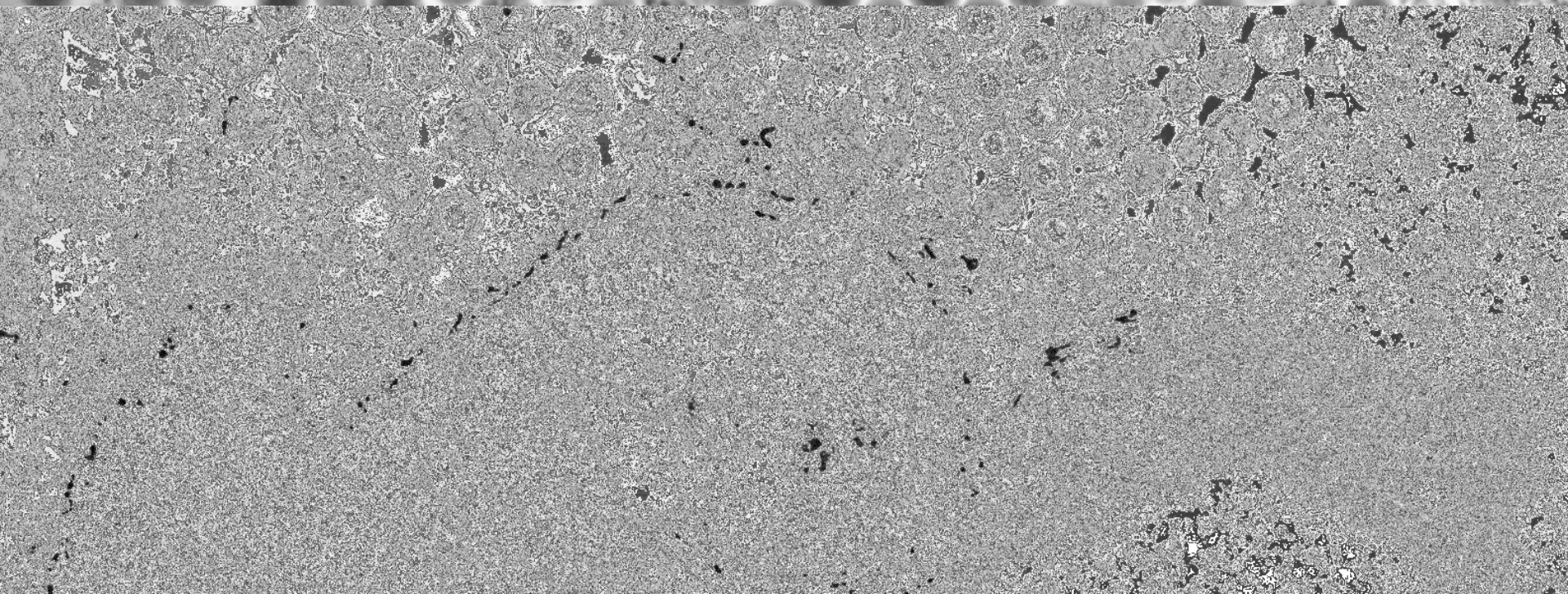
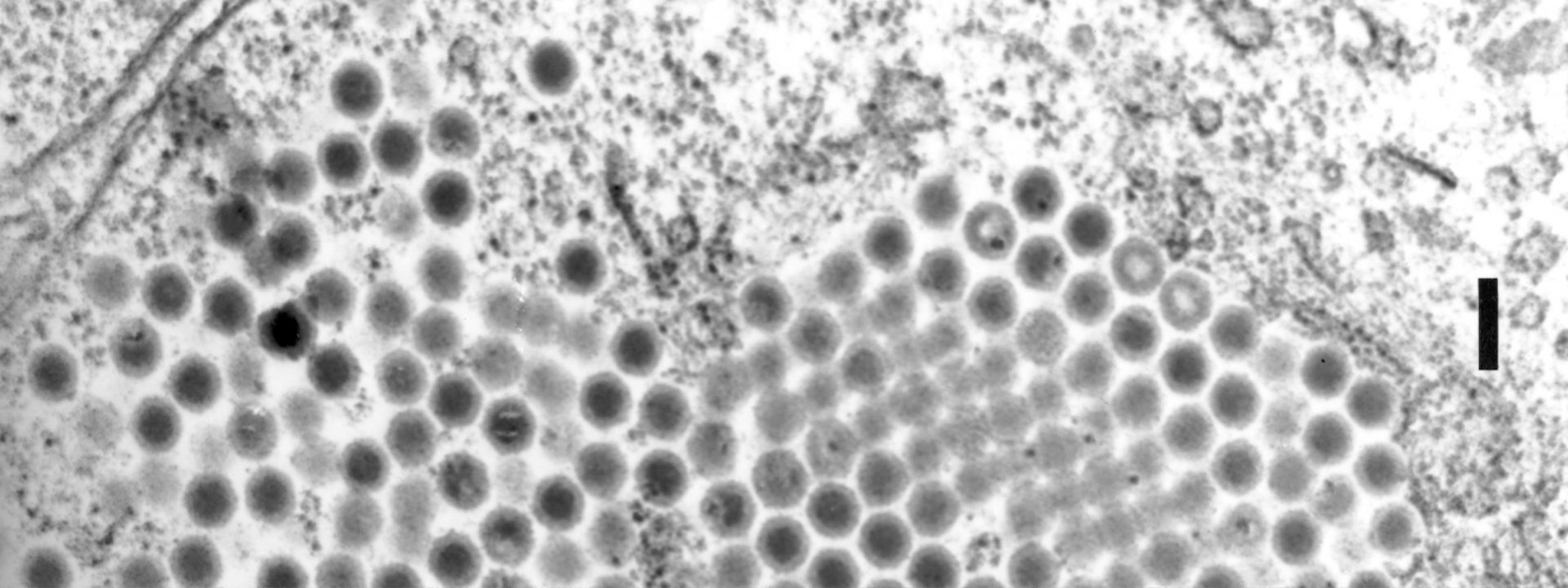




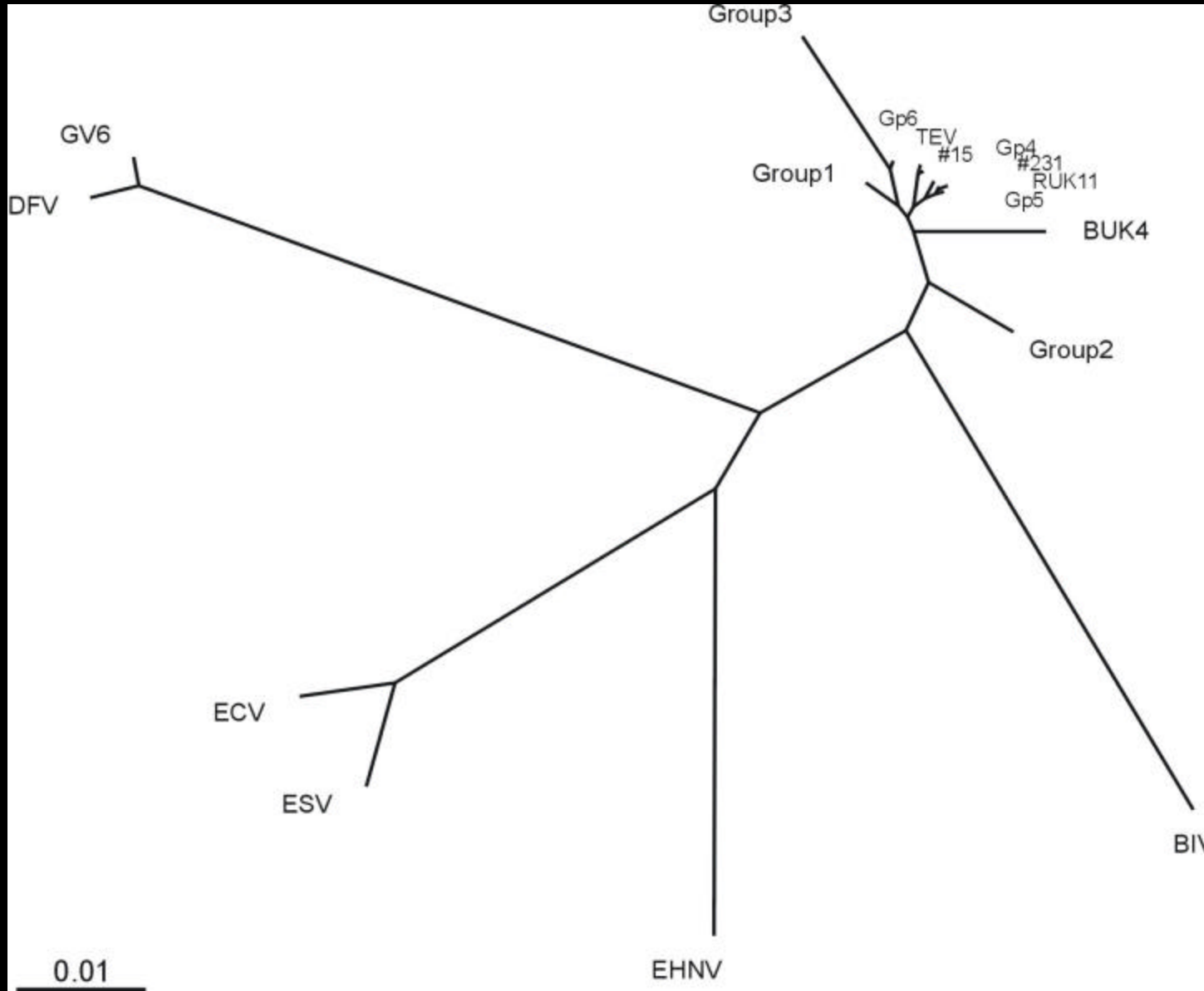








What is the origin of the UK ranavirus?



- Group 1: FV3, UK frog
- Group 2: UK frog, UK toad
- Group 3: S. Am. frog
- Group 4: UK frog
- Group 5: UK toad
- Group 6: UK tortoise

ANNUAL MONITORING OF TEN INDEX SITES OF FROG MORTALITY, 1992 - 1996

- Recurrent annual mortalities at 3 sites
- Decline in number of adult frogs seen at all ten sites
- Complete loss of adult frogs at one site
- Decline in amount of spawn seen at 8 sites
- Complete loss of 2 sites as a breeding pond

Impact on other species?



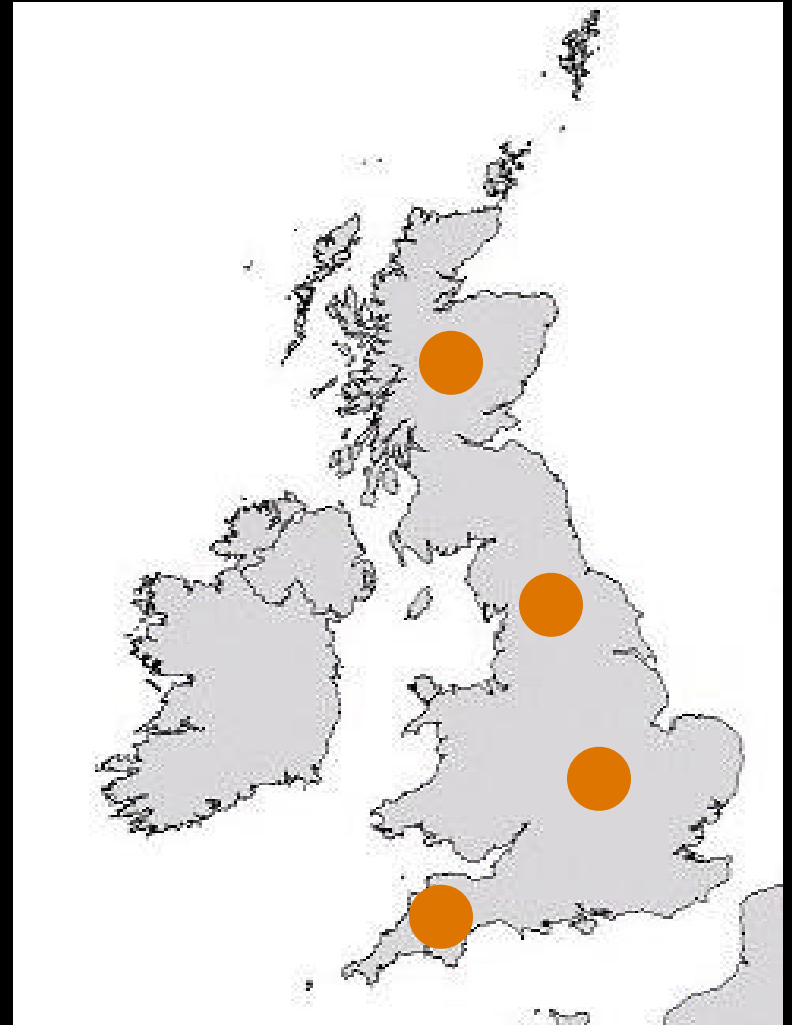
- “Concurrent fish deaths” was significantly ($p < 0.001$) associated with iridovirus mortality of frogs in the U.K.
- Fish killed experimentally by BIV (Australia) and naturally by RCV (U.S.A.)
- Toads (*Bufo bufo*) killed by U.K. frog ranavirus- what about other native amphibians?
- Tortoises killed by U.K. frog ranavirus – what about native reptiles?

Garden Bird Health Surveillance



2005 - 2008, UK Garden Bird Health *initiative*

- Scottish Agricultural College
- Department of Veterinary Pathology, University of Liverpool Veterinary School
- Institute of Zoology
- Wildlife Veterinary Investigation Centre

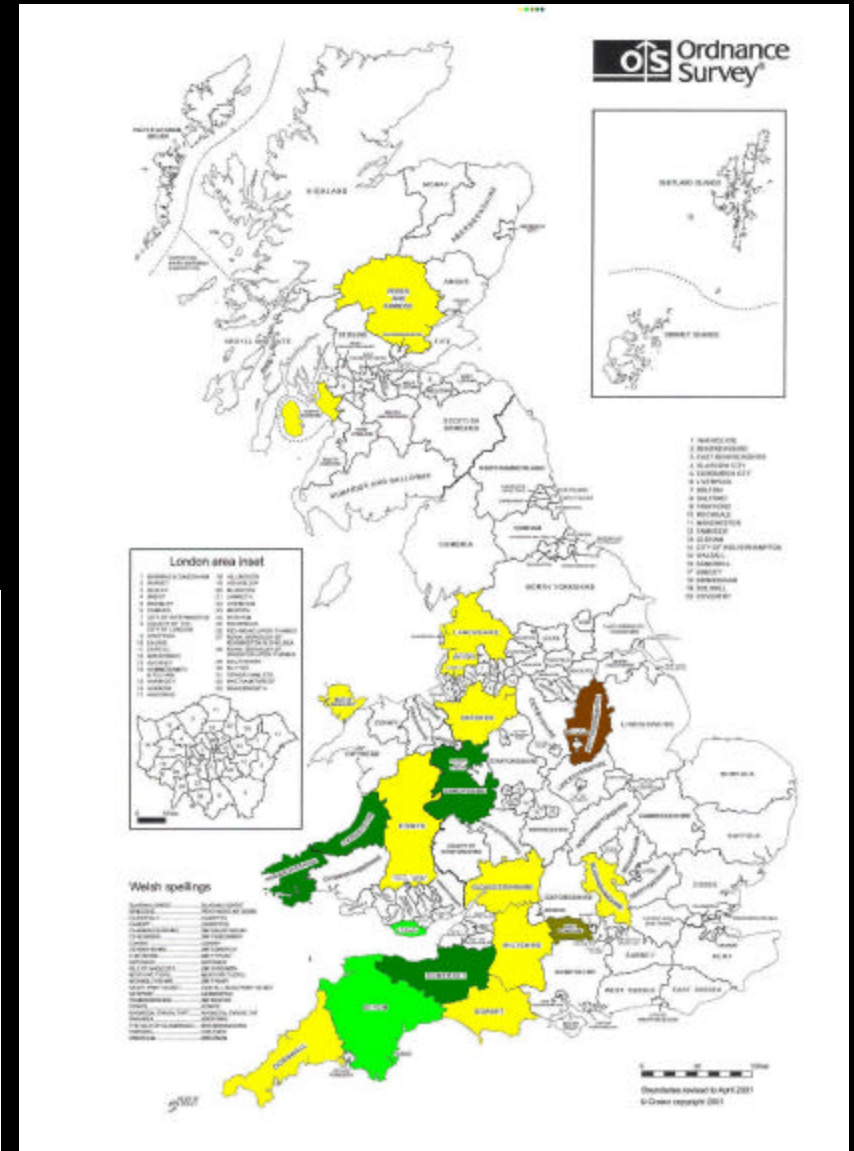
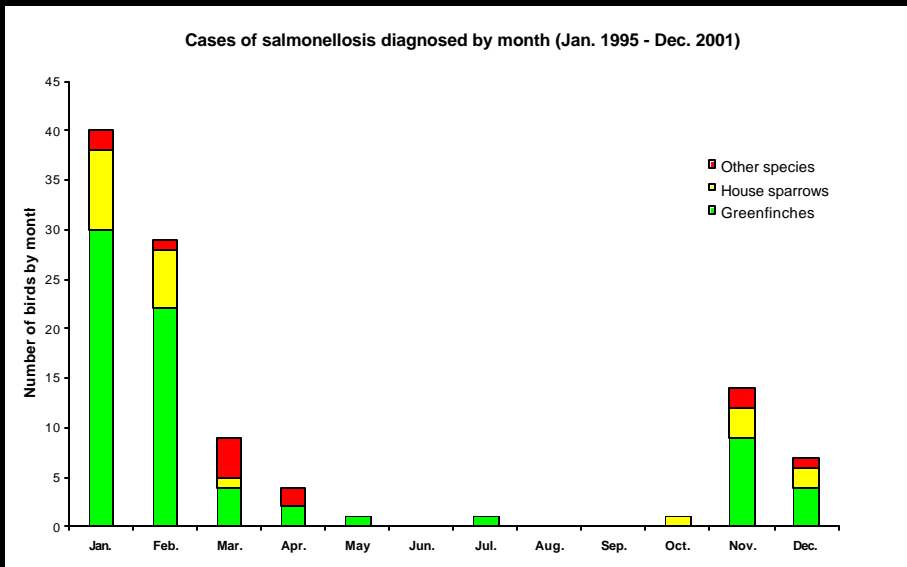


Garden Bird Health *initiative*



- Collaborative project, based on successful aspects of cetacean strandings, FMP & PDV projects
- Opportunistic monitoring of garden bird mortality
- Systematic surveillance of garden bird mortality (~ 1,000 GBW volunteers => known observer effort and improved data gathering)
- Network of disease investigation centres for PME
- Centralised database (including pathological and ecological data)
- National Garden Bird Sample Archive (enables continued & retrospective surveillance)

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Trichomoniasis of finches: a novel emerging infectious disease



Greenfinch with thickened crop wall



Necrotic foci due to trichomoniasis

Squirrelepox and red squirrel declines

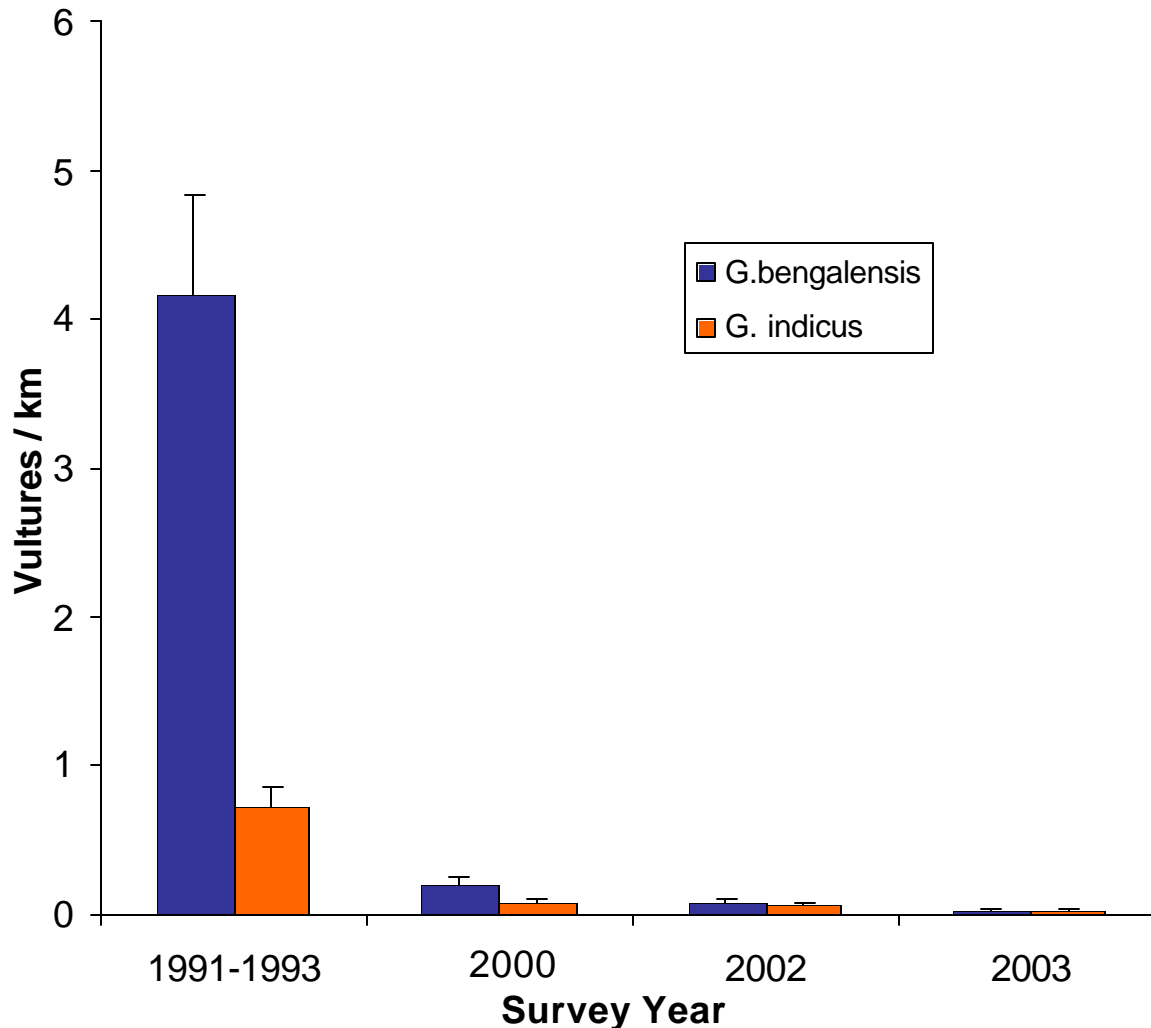


Sainsbury et al. (2000) *Animal Conservation* **3**, 229-233

Tompkins et al. (2002) *Proc. Roy. Soc. B* **269**, 529-533

Thomas et al. (2003) *J. Gen. Virol.* in press

Vulture declines in India



Rates of decline:

***G.b.* ~39%/year**

***G.i.* ~25%/year**

Graph showing degree of vulture declines detected during nationwide surveys across India (Prakash *et al.* 2003).







Final points



- Without co-ordinated disease surveillance with collaborative, multi-disciplinary (often multi-national) investigations, important diseases which threaten biodiversity and, in some cases, economic activities and human health, would remain unrecognised and undiagnosed.
- There is more to disease threats than just pathogens causing mass mortality events
- The more you look – the more you find: disease surveillance is an essential component of ecosystem management – and there is a need to establish base-line parameters wherever and whenever possible.